Docket - 64294-15

FUEL TANK HAVING MOLDED REINFORCEMENTS AND METHOD OF MAKING SAME

TECHNICAL FIELD

The subject invention generally relates to marine fuel tank assemblies and, more specifically to a blow-molded fuel tank assembly having reinforced corners and a method of making same. The method includes the step of molding reinforcements over a portion of a plastic fuel tank body.

Traditionally, plastic containers, such as fuel tanks, have been molded by a variety of techniques such as roto-molding and blow-molding. Historically, blow-molded fuel tanks have been disfavored since their corners are inherently thin. The thin corners leads to inherent weaknesses in the fuel tanks. Because fuel tanks must meet stringent governmental standards for both permeation and fire resistance, the prior art blow-molded tanks have been disfavored due to their proclivity towards permeation of fuel and decreased resistance to fire.

The prior art has not successfully addressed the problems set forth above for blow-molded fuel tanks. Thus, there has been a need for an improved blow-molded plastic container assembly which provides increased strength, low permeability, and increased fire resistance. There has also been a need for an improved blow-molding method of manufacturing these container assemblies.

SUMMARY OF THE INVENTION

The improved storage tank assembly of the present invention provides a blow-molded fluid sealed tank assembly without weakened corners which are typical in blow-molded plastic fuel tanks. The container assembly includes a plastic container body and at least one corner reinforcement. The reinforcement is molded over an outer surface of at least one corner of the container body. The reinforcement includes a peripheral edge which is partially embedded in the outer surface of the container body. The peripheral edge is also partially deformed and becomes partially cohesive with the outer surface of the container body providing locking engagement between the reinforcement and the container body.

In a method according to the present invention, a reinforcement is molded over the corner of a plastic container body leaving a portion of the reinforcement

partially embedded in the molded container body. A mold is provided having an inner surface and an orifice, wherein the inner surface of the mold defines an outer surface of the container body. A reinforcement is disposed in the mold orifice with the portion of the reinforcement to be embedded into the container body positioned in the mold. The reinforcement also includes at least one peripheral edge which is partially embedded in the container body. A fluid thermoplastic material is introduced into the mold and forced against the inner surface of the mold and the peripheral edge of the reinforcement. The fluid thermoplastic material softens or partially melts the peripheral edge of the reinforcement. The peripheral edge is partially deformed forming a locking engagement between the container body and the reinforcement. The thermoplastic material comprising the container body and the thermoplastic material comprising the reinforcement can also cohesively bond together providing a secure seal between the container body and the reinforcement. Thus, sufficient thickness can be obtained at the corners without using greater amounts of plastic in the blow-mold process.

In the preferred embodiment, a blow-molded process is used to mold the container assembly. In this process, a fluid parison of thermoplastic material is introduced into the mold and a pressurized gas charge is introduced into the parison expanding the parison and confirming the parison to the inner surface of the mold. The thermoplastic reinforcement is preferably made by injection molding utilizing the same thermoplastic material as is used to form the container body.

The ability to produce parts with good material thickness in corners without making the balance of the part much too thick just to improve corners.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a perspective view of a plastic container assembly in accordance with the present invention;

Fig. 2 is a partial cross-sectional view of the reinforcement and container body of the assembly taken along line 2-2 of Fig. 1;

Fig. 3 is a perspective view of the reinforcement in accordance with the present invention;

Fig. 4 is a cross-sectional view of the reinforcement during a molding step of a method in accordance with the present invention;

Fig. 5 is a cross-sectional view of a receiver in accordance with the present invention taken along line 5-5 of Fig. 4;

Fig. 6 is a cross-sectional view of an alternative embodiment of the reinforcement in an orifice of a mold prior to a molding step of a method of the present invention; and

Fig. 7 is a cross-sectional view of an alternative embodiment of the container assembly in accordance with the present invention.

DETAILED DESCRIPTION

Referring to Fig. 1, a storage tank or container assembly according to the present invention is generally shown at **20**. The tank includes a container body **22** which defines an interior **24** of the tank assembly **20**. The container body **22** is constructed of a plastic material, such as a thermoplastic, of the type known in the art, which is preferably made by a blow-molding process or other known processes. The thermoplastic material which comprises the container body **22** is preferably a high density polyethylene plastic material and has a general thickness of approximately 2 to 4 millimeters.

The tank assembly **20** also includes a plurality of fixtures **26**, **28**, **30**. Fixtures **26**, **28**, **30**, are pre-fabricated pieces and comprise, for example, an injection molded thermoplastic material. Fixtures **26**, **28**, **30** preferably comprise a high density polyethylene thermoplastic material. For reasons set forth below, the container body **22** and fixtures **26**, **28**, **30** preferably are made from the same thermoplastic material. However, fixtures **26**, **28**, **30** will be thicker than the material container body **22**. Typically, fixtures **26**, **28**, **30** will have a general thickness of approximately 4 to 7 millimeters. Fixtures **26**, **28**, **30** can each have a portion embedded in the container body **22**, as described below. Each fixture **26**, **28**, **30** provides an opening into the interior **24** of the tank assembly **20**. Each

fixture has a cap associated therewith which seals the interior **24** to retain a fluid in the interior **24** of the container assembly **20**.

The tank assembly **20** illustrated in Fig. 1 is a fuel tank of the type utilized in the marine industry. The fuel tank **20** includes an inlet cap **28** associated with fixture **26** through which fuel can be pumped into the fuel tank **20**. The fuel tank **20** also includes a fuel gauge assembly and a fuel line assembly **31** both associated with the fixtures **28** and **30**, respectively. Fuel disposed in the tank **20** is drawn through the fuel line assembly **31** and is conveyed through a fuel line to an engine. Although a fuel tank is illustrated, it should be understood that this invention extends to other types of containers. Thus, the invention will be described generally as relating to a conventional container assembly.

As shown in Fig. 1, each fixture **26, 28, 30** has a threaded outer surface which receives the cap **27, 29, 31**, respectively. The fixtures **26, 28, 30** allow for interchangeable components to be used. The fixtures **26, 28, 30** are uniformly designed receptacles adapted to receive any desired components. As should be apparent, the components illustrated could be assembled in the various fixture openings. For example, the cap **27** could be mounted in the middle and the fuel gauge **28** could be mounted on the end.

The fixtures **26, 28, 30** are embedded in the plastic container body **22**. This is shown and described in greater detail in co-pending application U. S. Serial No. 08/704,130, Attorney Docket 64294-008, assigned to the assignee of the present invention, and incorporated herein by reference.

Referring to Figs. 1-3, the container assembly **20** is shown having its top, bottom, and side walls intersecting in at least corner **32**. The corner **32** includes a reinforcement **40** disposed on an outer surface **34** of the corner **32**. Referring specifically to Fig. 3, the corner reinforcement **40** can include an indexing pin **42** disposed on a surface thereof which provides a mechanism for inserting and retaining the corner reinforcement **40** in a mold, which will be discussed in greater detail below.

Referring specifically to Fig. 2, the corner reinforcement **40** has a co-extensive peripheral edge **44**. The peripheral edge **44** has a substantially tapered

cross-section. The peripheral edge **44** of the corner reinforcement **40** is partially embedded in the outer surface **34** of the container body **22**. That is, upon molding of the tank body **22**, the molten thermoplastic material comprising the tank body **22** engulfs a portion of the peripheral edge **44**. The thermoplastic material which comprises the outer surface **34** of the corner substantially engulfs a bottom surface **45** of the peripheral edge **44** and substantially covers a top surface **46** of the peripheral edge. However, the plastic material comprising the tank body **22** is not disposed over any other portion of the corner reinforcement **40**.

The peripheral edge **44** of the corner reinforcement **40** can also become partially cohesive with the outer surface **23** of the tank body **22**. That is, if compatible thermoplastic materials are utilized for both the corner reinforcement **40** and the tank body **22**, the materials comprising the respective parts can form a cohesive bond therebetween. Additionally, the peripheral edge **44** of the reinforcement **40** can be partially deformed by the hot thermoplastic material comprising the tank body **22** and can thus provide locking engagement between the reinforcement **40** and the container body **22**. That is, the deformed peripheral edge **44** allows for a mechanical lock to be formed between the deformed peripheral edge **44** having the material comprising the tank body **22** disposed thereover.

As shown in Fig. 2, the outside wall of the corner **34** coexists with the corner reinforcement **40**. That is, although the corner reinforcement **40** is disposed about the outside corner **34**, both the outside corner **34** and the reinforcement **40** exist independently. A void space or gap **48** can be formed during the molding operation.

Referring to Fig. 7, an alternative embodiment of the present invention is shown. In this embodiment, an alternative corner assembly is shown. The corner assembly **50** includes a corner reinforcement **54** molded to an outer surface **52** of a corner. The reinforcement **54** includes a peripheral edge **56** and a vent hole **58**. The vent hole is provided to allow for the exchange of fluid between the reinforcement **54** and the hot thermoplastic material comprising the outside corner **52**. The vent **58** allows for the elimination of the void **48** shown in Fig. 2.

In Figs. 4-6, a process of the present invention is illustrated. As shown in Fig. 4, the corner reinforcement **40** is placed in an orifice **82** of a mold **80**. An inner surface **84** of the mold **80** defines an outer surface **23** of the container body **22**. The corner reinforcement **40** is disposed in the mold **80?**. The corner reinforcement **40** is secured in the mold **80?** by inserting the pin **42** into an indexing mechanism **86**. The indexing mechanism **86** includes a receiver **90** disposed in an aperture **92** of the mold **80?**. The receiver **90** includes a cylindrical portion **94** disposed in the aperture **92**. The cylindrical portion **94** includes a bore **96** adapted to receive and retain the pin **42** of the corner reinforcement **40** therein. The receiver **90** further includes a base portion **98** disposed in a recess **104**. The base portion **98** is laterally displaceable within the recess **104**.

Springs **100** disposed in bores **102** laterally bias the receiver **90** within the aperture **92**. When the pin **42** of the corner reinforcement **40** is disposed within the bore **96** of the receiver **90**, the springs **100** provide a lateral force on the receiver **90** to force the corner reinforcement **40** into engagement with the inner surface **84** of the mold **80**. This mechanism insures that the corner reinforcement **40** will be maintained in its proper position during the molding operation and to allow controlled movement of the corner reinforcement **40** due to molding forces and thermodynamic effects such as expansion and contraction of the materials disposed within the mold **80**. A keeper plate **106** disposed adjacent to the base portion **98** and the recess **104** retains the indexing mechanism within the mold **80**.

As discussed above, a vent hole **58** can be disposed in the corner reinforcement **54**. With reference to Fig. 6, the mold **80** includes a vent **120** disposed in fluid communication with the vent hole **58** of the corner reinforcement **54** to allow for the flow of fluid therebetween.

In the process of the present invention, a hot fluid thermoplastic material is simultaneously disposed over both the inner surface **84** of the mold **80** and the peripheral edge **44**, **52** of the corner reinforcement **40**, **54**. This step can be performed, for example, by any plastic molding method which is well known in the art. The preferred plastic molding method is blow-molding. In this process, a molten parison of fluid thermoplastic material may be disposed in the interior **81** of

the mold **80**. A pressurized gas, such as air, is then blown into the parison in the mold **80**, thereby expanding the parison and conforming the parison to the inner surface **84** of the mold **80**. The hot fluid thermoplastic material contacts the peripheral edge **44**, **52** of the corner insert **40**, **54** and can begin to soften or even melt at least a portion of the peripheral edge **44**, **52**.

The fluid thermoplastic material cools and hardens forming the container body **22**. As the fluid thermoplastic material cools, limited shrinkage of the thermoplastic material can occur, drawing the peripheral edge **44**, **52** and the container body **22** together. The peripheral edge **44**, **52** can be deformed, thereby producing locking engagement with the container body **22**. Additionally, as discussed above, cohesive bonding between the peripheral edge **44**, **52** and the fluid plastic material comprising the container body **22** can also occur.

A preferred description of this invention has been disclosed; however, one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied in order to determine the true scope and content of this invention.